**System of Particles Summary Sheet**

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| **Impulse** | **Linear Momentum** |
| 1. **Impulse = FΔt**    1. **F** = Applied Force (N)    2. Δt = time interval (s) 2. Impulse can be positive, negative, or zero 3. Units are N-s 4. Impulse is a vector quanty, same direction as **F** | 1. **Linear Momentum** is the product of mass and velocity 2. **p** = m**v** m = mass (kg), **v** = velocity (m/s) 3. Momentum is a vector, same direction as the velocity 4. Units are kg\*m/s |
| **Impulse Momentum Theorem** |
| **Impulse = change in momentum**  **F**Δt **=** m**vf –** m**vo**  This is a vector equation, **F, vf**, and **vo** are vectors. |
| **Collisions and the Conservation of Momentum** | |
| 1. If the sum of all external forces on a collection of objects is zero, the total momentum of the system is conserved and does not change. 2. All collisions between objects involve only “internal” forces and are equal and opposite.   **P**f = **P**o This is a vector equation  m1**v**f1 + m2**v**f2 = m1**v**o1 + m2**v**o2  **Types of Problems** | |
| 1. Two objects collide and stick together (two train cars : (m1**v**1 + m2**v**2) = (m1 + m2) **v**f (**v**f = **v**f1 = **v**f2) | |
| 1. Two objects collide and separate: (m1**v**o1 + m2**v**o2) = (m1**v**f1 + m2**v**f2) | |
| 1. Two objects initially at rest separate: 0 = m1**v**f1 + m2**v**f2 **v**o1 = **v**o2 = 0 **P**o = 0 = **P**f | |